

# **AN APPROACH FOR PEER REVIEW of SUSA PRA LEVEL-1**

**Fifth International Information Exchange Forum  
SAFETY ANALYSIS for NPPs of VVER & RBMK  
Types**

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# PROJECT DESCRIPTION

- Funding Provided by U.S. Department of Energy
- Prepared Under Contract with Pacific Northwest Laboratory
- Technical Cognizance by Brookhaven National Laboratory

# INITIAL & BOUNDARY CONDITIONS

- SUSAN PRA IS ALREADY PERFORMED & INDEPENDENT PEER REVIEW IS AN INTEGRATED PART OF ISA PROJECT
- LIMITATIONS IN FUNDING
- LIMITATIONS IN RESOURCES
- LIMITATIONS IN TIME

# PEER REVIEW PROJECT STAGES

- PEER REVIEW of SUPGs
- THE PRA TECHNICAL WORK PEER REVIEW METHODS & PEER REVIEW PLAN DEVELOPMENT
- SUSAs PRA TOP LEVEL REVIEW
- PEER REVIEW PLAN ADJUSTMENT
- IN-DEPTH REVIEW:
  - SELECTIVE REVIEW
  - VERTICAL SLICE APPLICATION

# **PEER REVIEW PLAN**

## **(TABLE OF CONTENTS)**

- **INTRODUCTION**
- **OBJECTIVES OF PEER REVIEW**
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# PEER REVIEW PLAN (ctnd.1)

**Both TOP-LEVEL & IN-DEPTH REVIEW PLANS  
(for each PRA element) are of the same structure:**

1. Document under review
2. Main objectives
3. Information required for review
4. Review Procedure (review method, main steps & evaluation criteria)
5. Review results Documentation

# **EVALUATION CRITERIA**

(PRA element: “SYSTEM DATABASE”)

## **A. PROCEDURAL & DOCUMENTATION REVIEW:**

### **Compliance with SUPG**

- The work described in the Work Package is prepared and reported using the procedures described in SUPG

### **Assessment of the Documentation**

- the Work Package is clearly written and adequately documented (documented according to the requirements of SUPGs)

# **EVALUATION CRITERIA**

## **(ctnd.1)**

- the origin of the information used is predicated directly on South Ukraine Nuclear Power Plant (SUNPP) documentation and operating experience (preliminary conclusion)
- each system description is reasonably complete and traceable
- assumptions applied and limitations imposed are clearly presented, and adequately documented
- there is no any obvious errors and omissions in the System Data Documentation



# **EVALUATION CRITERIA**

## **(ctnd.2)**

### **B.MODELING AND DATA REVIEW**

#### **Technical Basis and Completeness of SUNPP System Database Analyses**

- the basis and procedure for assuring completeness of SUNPP system database is adequately described (as SUPGs)
- the list of systems described is complete enough (preliminary conclusion)
- system design purposes and safety functions to be provided by the system are clearly stated. System design bases success criteria is clearly defined

# EVALUATION CRITERIA (ctnd.3)

- system boundaries are established and unambiguously described
- system dependencies are clearly presented
- each system description is followed by a FMEA analysis.
- FMEA results correlate with those in a PRA of similar plant
- list of component operational and failure modes is consistent with the “Reliability Database Collection” deliverable and with a PRA of similar plant
- description of a safety function to be provided by a system is consistent with those presented in the “Success Criteria Analysis” and “Initiating Events Identification and grouping ” deliverables

# EVALUATION CRITERIA

## (ctnd.4)

- information pertinent to system operability and availability control is complete enough (preliminary conclusion)
- all the assumptions and limitations are consistent and complete

# PROCEDURE

(PRA element: “SYSTEM DATABASE”)

Top Level Review is concerned with formal aspects of the system database task of the PRA. The Top Level Review surveys the apparent completeness of the deliverable, it's scrutability, and determines to what extent the deliverable can usefully be further examined.

The main steps of the system data documentation top-level review are:

# PROCEDURE

## (ctnd.1)

- Understand the overall structure of the Work Package
- Break-down the documentation of the Work Package into the following main Review Components:
  - Systems Description, and
  - Failure Mode Effect Analysis
- Make (for each of the above Review Components) a Top Level Evaluation Criterion Checklist: a table of the PR Team's expectations for a "quality" PRA (based upon the set of associated evaluation criteria and taking into account the most important comments derived from the peer review of SUPG versus the associated items presented in the SUSA PRA)

# PROCEDURE

## (ctnd.2)

- Note discrepancies and omissions
- Make a note of sources and analysis used for each item (e.g., the plant operational procedure, FMEA analysis, similar plant PRAs, etc.)
- Explain the discrepancies based on SUPG requirements and plant specific considerations:
  - knowledge of the plant systems operation, and test and maintenance features.
  - plant occurrences, plant failure data.
  - justifications and assumptions used.

# PROCEDURE

## (ctnd.3)

### ■ Answer the following questions:

- are the work package report and supporting documentation clearly written, complete enough and traceable?
- are the sources and analyses applied in the PRA appropriate?
- is the list of systems complete enough?
- is the scope and nomenclature of information provided in the deliverable sufficient to proceed with the system modeling aspects?
- is there any additional information required?
- what are the issues to be included into a top level review check list of an interfacing PRA element (e.g., Success Criteria deliverable, Fault Tree, HRA deliverable, etc)?
- what are the main issues (if any) to be resolved together with the Second Reviewer (**GRS**) and /or the PRA team (via BNL)?

# VERTICAL SLICE

The “vertical slice” is a part of overall In-Depth Review process and it will be applied at the final stage of the SUSAN PRA review. The “vertical slice” provides a consistent and integrated framework for qualitative and quantitative examination of some selected issues arisen from detailed consideration of:

- dominant contributors to CDF of the SUSAN PRA
- the most important insights gained from a similar plant PRA, and
- the most important findings derived from the previous steps of the SUSAN PRA in-depth review.



# VERTICAL SLICE

## (ctnd. 1)

- The objective, scope and extent of a “vertical slice” depend upon the nature of the issue under examination.
- It is expected that two types of “vertical slice” will be applied for the SUSA PRA peer-review:
  - full-scope “vertical slice”, and
  - limited-scope “vertical slice”

The basic idea of the **full-scale** “vertical slice” is to track selective initiating event from “top” to “bottom” (e.g., starting with the modeling of ASs, followed by success criteria analysis / FT development, and ending with pertinent data analysis/ASs re-quantification). A full-scope “vertical slice” might be requested either by ET&D or by GRS analyst (as a result of in-depth review of “IE Identification & Grouping”/“ET modeling” SUSA PRA elements and GRS experience gained from previous safety analyses for VVER type of reactors).

# VERTICAL SLICE

## (ctnd.2)

**The limited-scope** “vertical slice” is quite similar to the full scope “vertical slice” with the only exception that the limited-scope “vertical slice” might be initiated at any point between the “top” and “bottom” and it can proceed either “upwards” or “downwards” depending on both the nature of an issue to be examined and the level of confidence resulting from the in-depth review of associated PRA element. It is essential that an issue selected for the limited-scope “vertical slice” shall be related to one of those PRA aspects, which conventionally have the greatest effect on quantitative or qualitative results of a PRA, e.g.:

- initiating event definition
- initiating event frequency estimation ( both technique and data)
- definition of a “core damage”- related End State

Peer Review of the SUSA PRA Level-1

# VERTICAL SLICE

(ctnd.3)

- success criteria definition
- initiating event grouping technique
- the plant modeling assumptions and limitations
- common cause and subtle failure treatment
- HRA data and methodology applied
- consideration of the plant - specific design features
- consideration of the plant - specific EOP features
- consideration of inter-unit dependencies
- the plant model final aggregation accuracy, the model verification and quantification
- consideration of IRRAS limitations

# VERTICAL SLICE DIAGRAM

